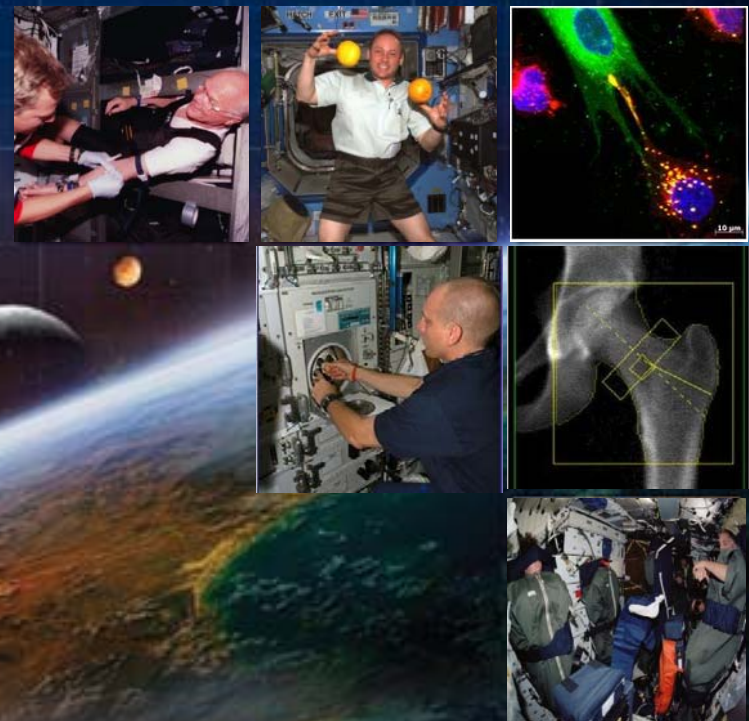


National Aeronautics and Space Administration



Human Research Program Opportunities

**3rd ISS Research and
Development Conference
Chicago, IL
18 June 2014**



**Craig E. Kundrot, Ph.D.
Deputy Chief Scientist, HRP
SA2/NASA JSC**

Human Research Program Goal



The goal of HRP is to provide human health and performance

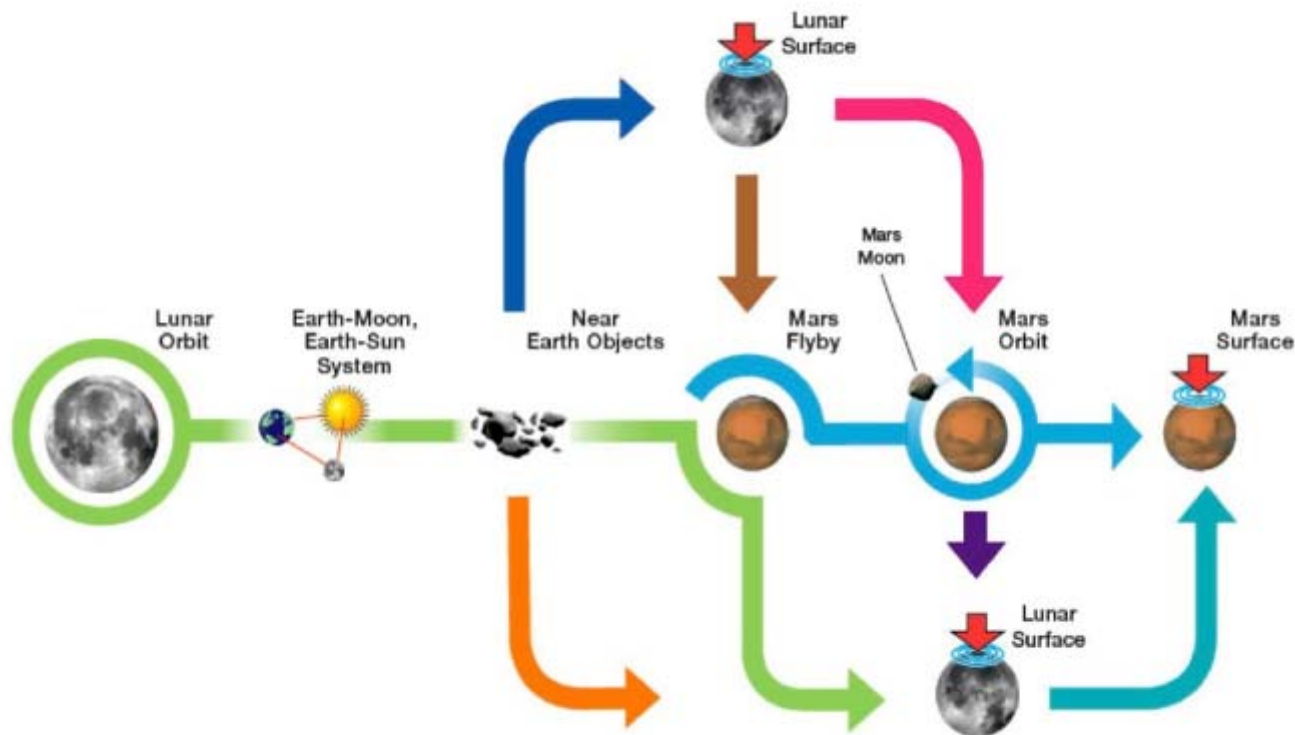
countermeasures,
knowledge,
technologies, and
tools

to enable safe, reliable, and productive human
space exploration.

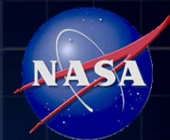


18 June 2014

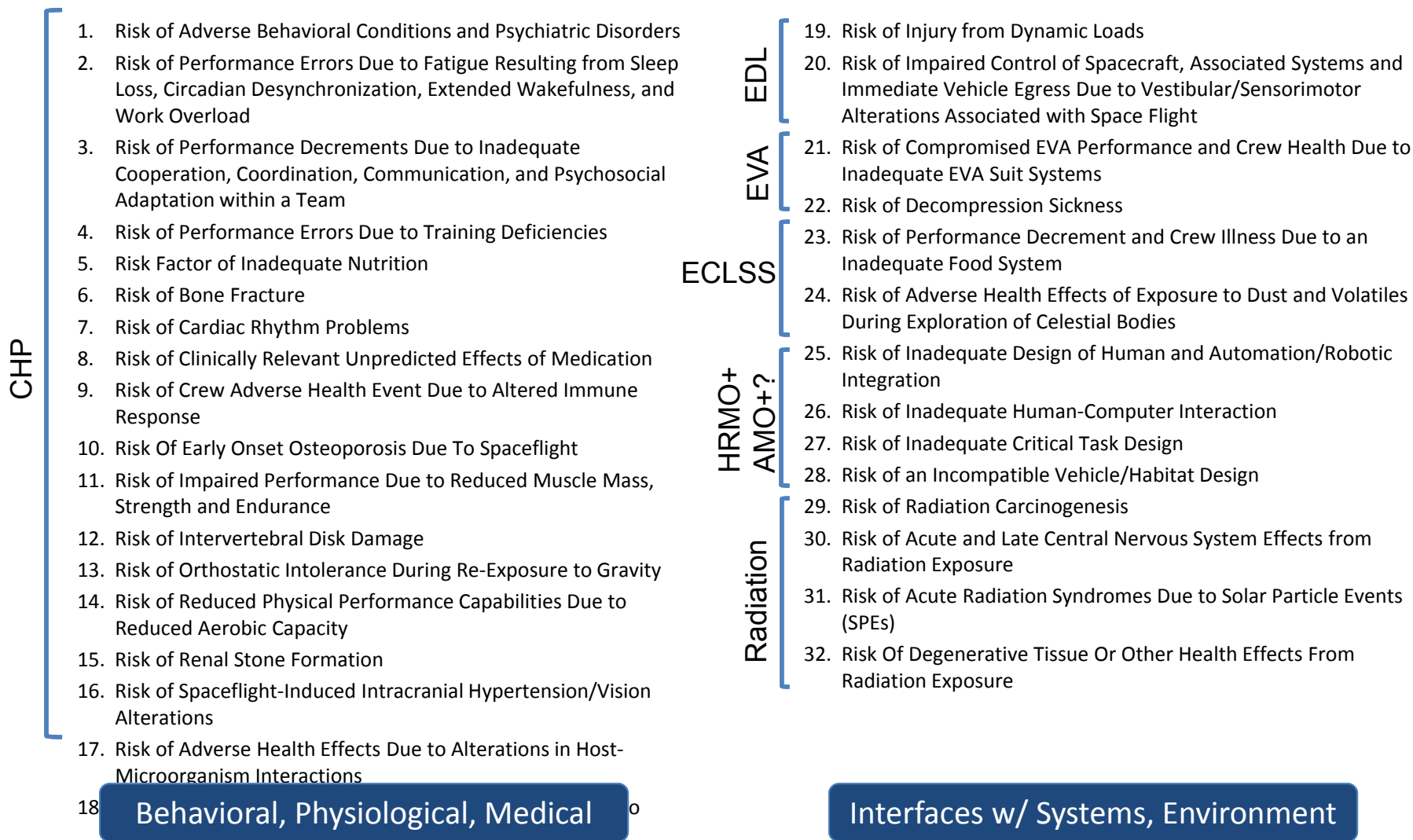
Future Missions: The Flexible Path



Schedules for the next destinations are unknown, but the goals are all beyond Low Earth Orbit (LEO)



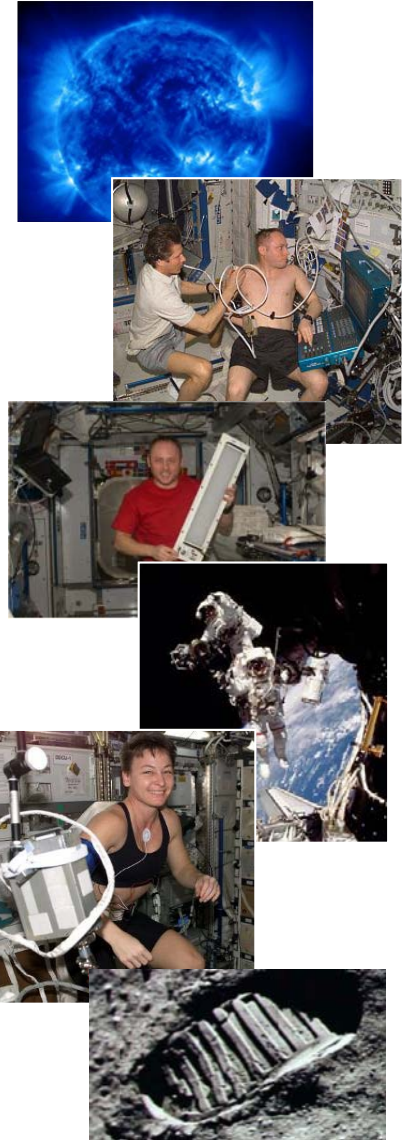
Risks Requiring Human Research



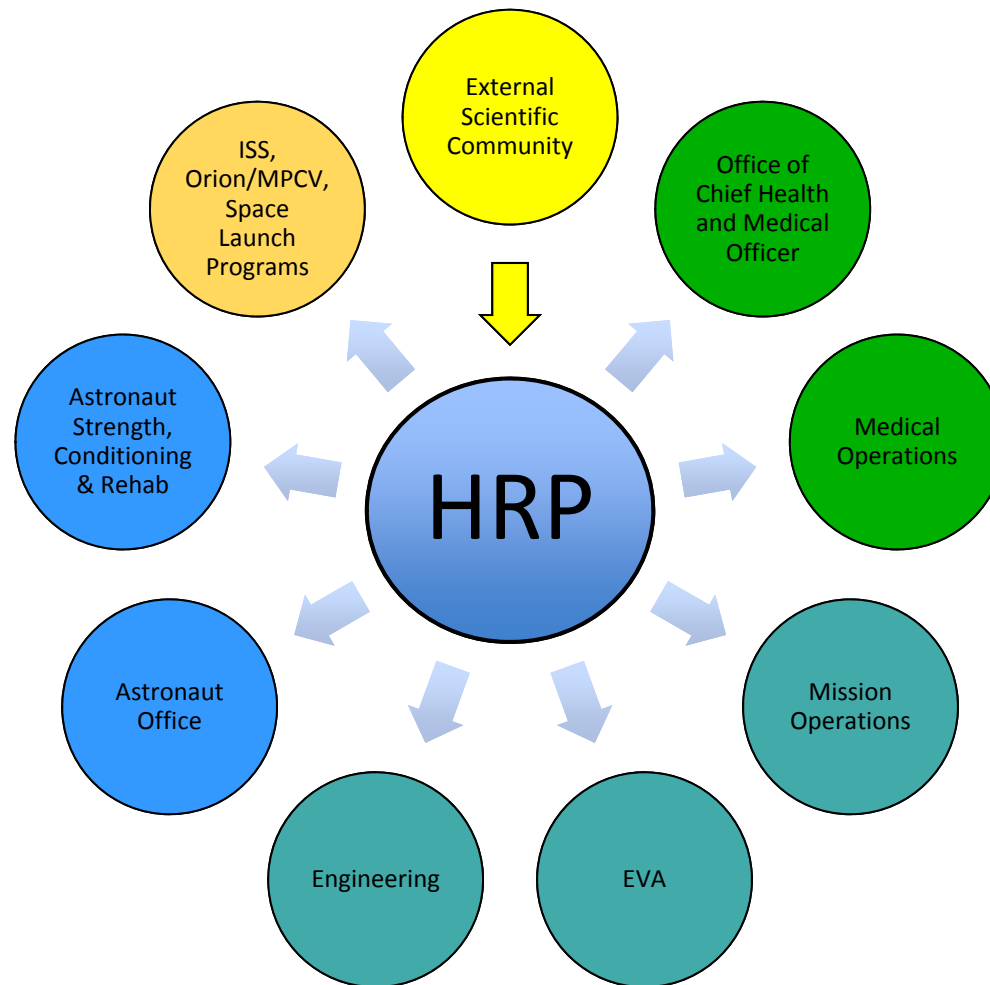
Overview: Components of HRP



- **Space Radiation**
 - ❖ Human health effects, limiting factors for vehicle environments and crew selection; computational shielding modeling; measurement, warning technologies
- **Exploration Medical Capability**
 - ❖ Medical care, crew health maintenance technologies (monitoring, diagnostic, treatment tools, techniques); medical data management; probabilistic risk assessment
- **Human Health Countermeasures**
 - ❖ Integrated physiological, pharmacological, nutritional countermeasures suite; Extra-Vehicular Activity (EVA) related physiology research to support new EVA suit development
- **Behavioral Health & Performance**
 - ❖ Behavioral health, performance monitoring tools, countermeasures (sleep/circadian; neurobehavioral; psychosocial), crew composition, selection, assessment, training capabilities; intervention, communication techniques to support exploration missions
- **Space Human Factors & Habitability**
 - ❖ Anthropometry, display/control, usability, cognition, habitability, lighting, ergonomics; advanced food development; lunar dust characterization, toxicological testing, characterization of microbiological hazards
- **ISS Medical Project**
 - ❖ ISS research integration and operations
- **National Space Biomedical Research Institute (NSBRI)**
 - ❖ Nationally competed, peer-reviewed research projects addressing HRP content utilizing investigators at more than 63 institutions in 23 states
- **Program/Science Management:**
 - ❖ Overall leadership of the program, support and integrate program science, policies and processes, and oversight of NSBRI Cooperative Agreement



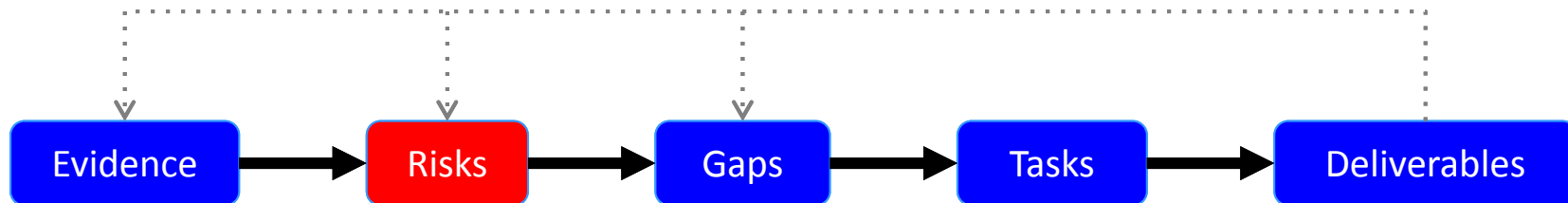
Integration With Other Organizations



10 Sept 2013



Program Architecture



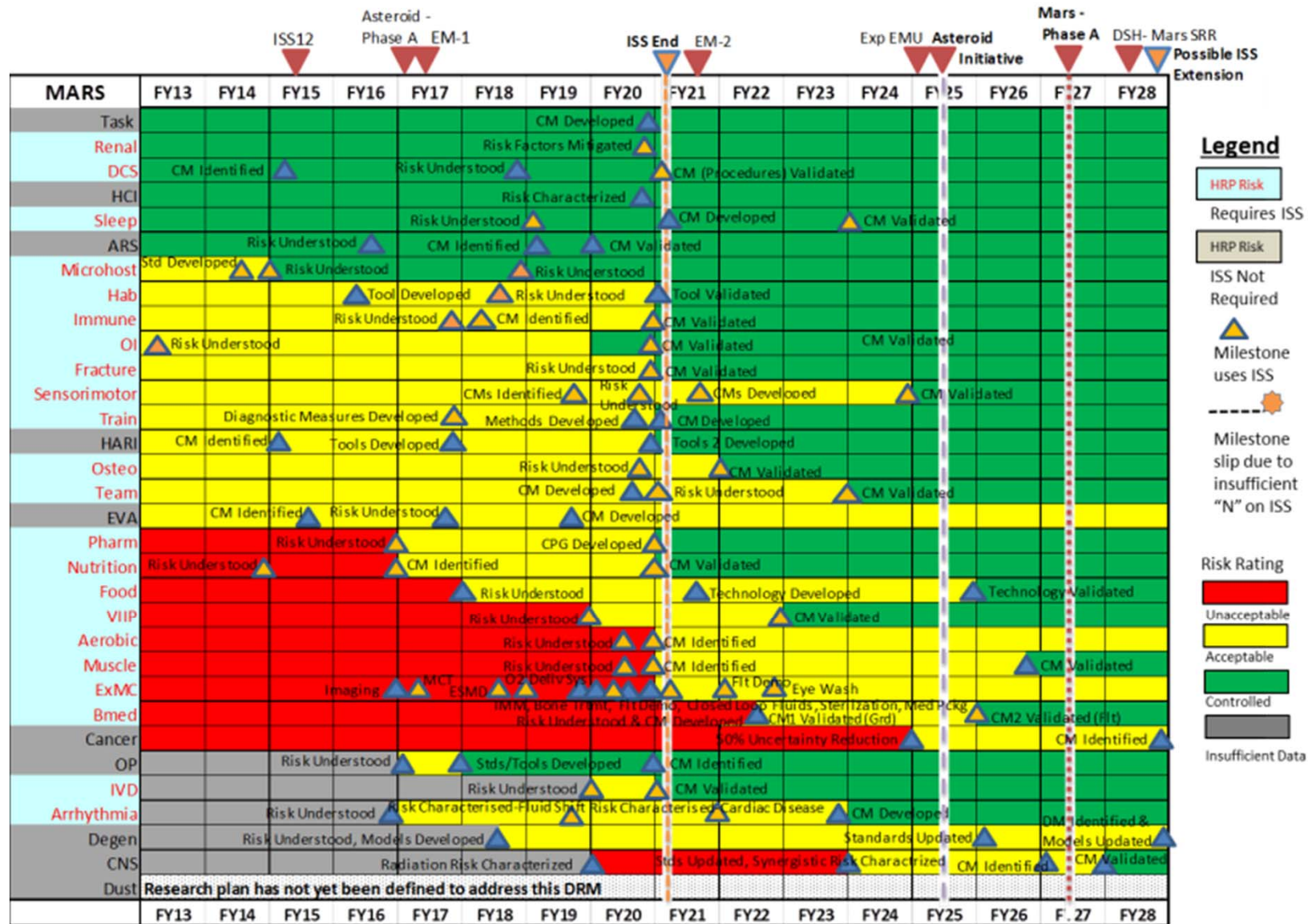
32 Risks
279 Gaps
963 Tasks

<http://humanresearchroadmap.nasa.gov/>

HRP Path To Risk Reduction

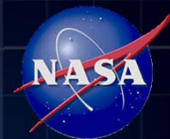


Under Revision

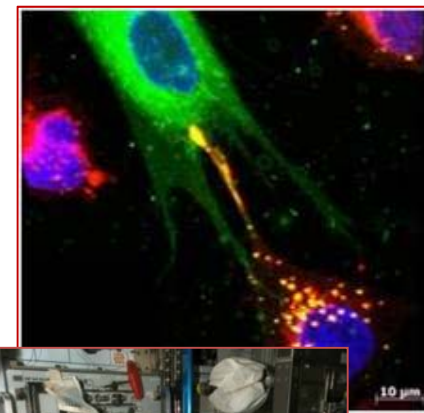


18 June 2014

Overview: Human Research Program



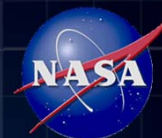
- **Established in 2005 to focus NASA's research on highest risks to human health & performance during exploration missions**
 - ❖ Perform research necessary to understand and reduce spaceflight human health and performance risks in support of exploration
 - ❖ Develop technologies to reduce medical risks
 - ❖ Develop NASA spaceflight human system standards
- **Highest health risks associated with exploration missions have been identified, documented, reviewed, and are actively managed**
- **Research underpinnings have been established by National Academies**
- **Independent, external scientific review used extensively**
- **Collaborative research with Internationals, other U.S. Agencies**
- **Products include:**
 - ❖ Information to design exploration architectures, vehicles, and missions
 - ❖ Countermeasures
 - ❖ Research deliverables that define space medical, environmental and human factors standards (standards define acceptable human health risk)
 - ❖ Technologies and Tools





Solicitations

- **NASA Research Announcement (NRA)**
 - ❖ Human Exploration Research Opportunities (HERO)
 - ❖ Released annually, typically at the end of July
 - ❖ Solicits ground-based, bed rest definition and flight definition proposals
 - ❖ Issued jointly by NASA HRP and the National Space Biomedical Research Institute (NSBRI)
 - ❖ Topics are derived from HRP Integrated Research Plan, <http://humanresearchroadmap.nasa.gov>
 - ❖ “Flagship”- special emphasis topics currently under review
 - ❖ “Omnibus”- solicitation for investigations ≤ 1 year providing innovative approaches to any defined risk in the HRP Integrated Research Plan
 - ❖ International collaborators on U.S. proposals that demonstrate clear scientific benefits or cost savings are particularly encouraged
 - ❖ 2014 HERO will be available through NASA Research Opportunities homepage at <http://nspires.nasaprs.com>
 - NRA to be issued: July 30, 2014
 - Step-1 Proposals to be due: September 4, 2014
 - Step-2 Proposals to be due: December 3, 2014
 - Award notification: April 2015



Other Mechanisms

- **Other Solicitations**

- ❖ **Experimental Program to Stimulate Competitive Research (EPSCoR)**

- Directed at PIs in jurisdictions that have not in the past participated equably in competitive aerospace and aerospace-related research activities (e.g., Wyoming)
 - EPSCoR solicitation typically released in first quarter of each year
 - <http://www.nasa.gov/offices/education/programs/national/epscor/home/index.html>

- ❖ **Small Business Innovation Research (SBIR)**

- Targeted at PIs working at small businesses with 500 or fewer employees
 - SBIR Program funds the research, development, and demonstration of innovative technologies that fulfill NASA needs and have significant potential for successful commercialization
 - SBIR Program has three phases
 - Solicitation is typically released in November of each year
 - <http://sbir.gsfc.nasa.gov/>

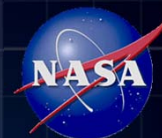
- **Unsolicited proposals**

- ❖ NASA encourages the submission of unique and innovative unsolicited proposals which will further the Agency's mission
 - ❖ May be sent by any PI at any time to:
Unsolicited Proposal Office
Mail Code BA
2101 NASA Parkway
Houston, TX 77058-3696



Special Characteristics of HRP Research

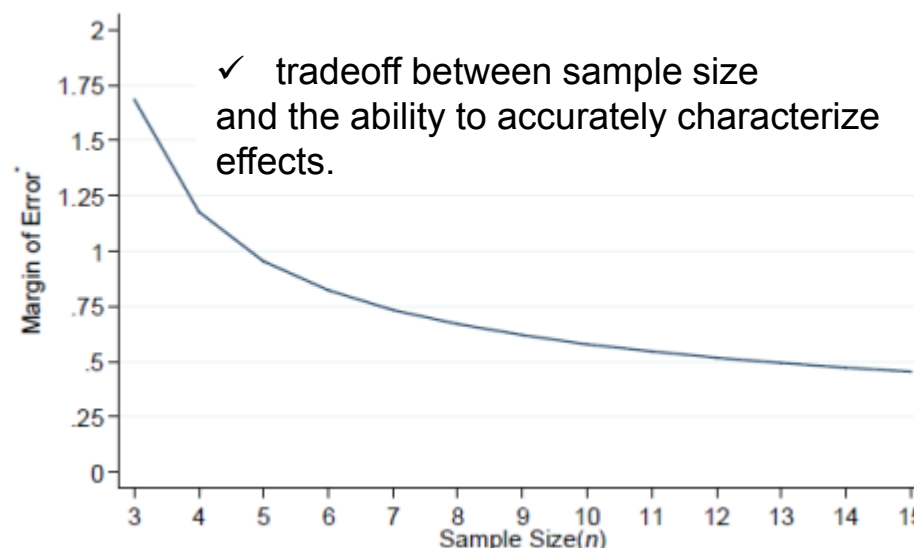
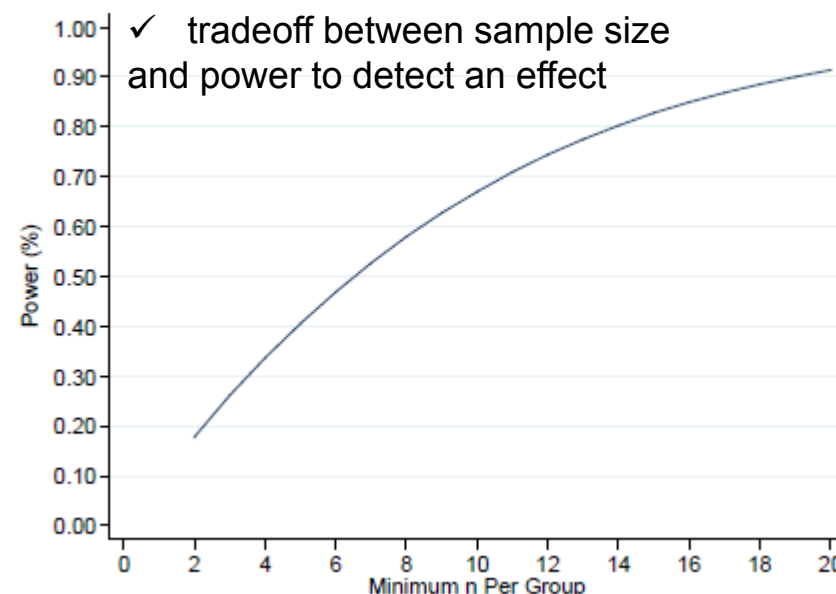
- **HRP conducts risk based research.**
- **Flexibility to replan or address new issues as needed.**
- **Limited time to get the “best” answer.**
- **Unique constraints.**
 - ❖ Small “n”
 - HRP considers ISS 1 year mission and ‘n’= 1 important
 - ❖ Constrained environments and often poorly controlled, less than ideal research conditions
- **HRP & NASA must make important decisions based on current information available.**
- **While awaiting a specific design reference mission HRP proactively defines critical mission attributes to guide research.**
 - ❖ Example: Duration (< 6 mo., > 6 mo.), communication delay
- **Obtain information and devices that have an immediate benefit to planned NASA exploration missions.**
- **Require access to exploration conditions, microgravity and space radiation.**
 - ❖ ISS and appropriate terrestrial analogs



How large does 'n' need to be?

- **Detecting meaningful changes/effects, for example, the ability of a novel intervention to reduce negative consequences of spaceflight on the human by XX %, relative to current standards.**
- **Flexibility for NASA to balance research resources across identified risks given low 'n' and constrained research conditions**

NASA → can be a leader in refining and promoting approaches to small 'n' research



ISS Research – Human Research Program

Critical to mitigating 19 of 31 health risks relevant to human exploration



On-Orbit Research Facilities



Human Research Rack-1



Exercise Facilities



Human Research Rack-2

Biomedical Research



Nutritional Requirements



Physiological Changes
and Exercise
Countermeasures



Immunological Changes



Crew Sleep and
Performance Research

Biomedical Capabilities Development



Lightweight Trauma
Module



Integrated health care
system



Portable Medical Imaging

IV Fluid
Generation



International Research Collaborations



ESA Muscle
Physiology Facility



CSA Cardiovascular
Function Experiment



JAXA Bone Loss
Countermeasure
Experiment



Russian Fluid Shift
Countermeasure
Experiment



Conclusion



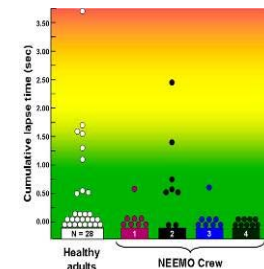
- **Human Research Program was designed to meet needs of human space exploration**
 - Understand and reduce the risk to crew health and performance in exploration missions
- **Strategy and Approach**
 - Evidence/Risk-based Program Architecture:
Evidence → Risks → Gaps → Tasks → Deliverables
 - Use a competitive solicitation process and peer review to fund Tasks that produce Deliverables to define or reduce risk
- **Deliverables**
 - Research deliverables that define space medical standards
 - Information to design exploration architectures, vehicles, and missions
 - Countermeasures
 - Research support for efficient medical operations
 - Space biomedical technologies and tools
- **Funding mechanisms**
 - NASA Research Announcement (HERO)
 - EPSCoR
 - SBIR
 - Unsolicited Proposals



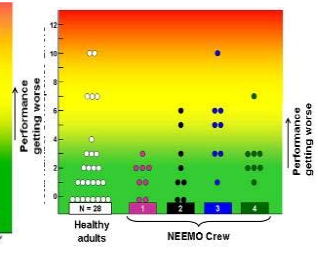
Clay Anderson
performing CCISS
during Inc 16



Exploration task
test



N9 Errors of
Omission (lapses)



N9 Errors of
Commission
(false starts)



Vibe bedrest study